

# ENERGY ANALYSIS

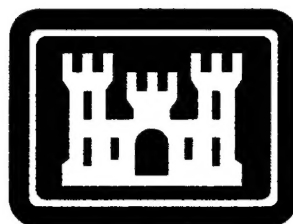
FOR

Fort McNair

Marshall Hall

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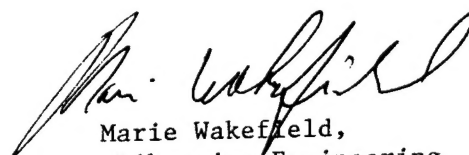


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ENERGY ANALYSIS**

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## 1.0 EXECUTIVE SUMMARY

Marshall Hall was selected by the US Army Corps of Engineers to participate in the Energy Efficiency Analysis Program. The objective of this program is to assist military installations in identifying energy usage and cost saving projects at their facilities and possibly provide funding for projects. Entech Engineering, Inc. was selected to perform this study.

Ft. McNair spent \$444,600 on energy for Marshall Hall, \$1.83 per square foot, during fiscal year 1993. Of this amount, electricity comprised 78% of the cost while the remaining 22% was from natural gas. Entech has identified the following areas as having the greatest cost savings potential:

Lighting
Boiler Operation
Cooling System Operation
Energy Management System Operation
Kitchen Equipment

A total of twenty-seven (27) Energy Conservation Opportunities (ECOs) were developed and evaluated. ECOs describe the means to reduce energy consumption and operating cost. Of the twenty-seven (27) ECOs, fourteen (14) have been developed as economically feasible. The remaining thirteen (13) investigated did not prove to be economically attractive.

The economic feasibility of a recommended ECO is measured by the simple payback period and savings to investment ration (SIR). Entech and the EEAP

Program recommend that ECOs with a simple payback period of under ten (10) years and SIR greater than one (1.0) should be further considered for implementation. ECOs with payback periods of under four (4) years should be considered for more immediate implementation.

The estimated total cost for the construction of the recommended ECOs is approximately \$607,700. The estimated annual energy savings are about \$180,400 for a 41% reduction from current energy expenditures. This savings yields an average simple payback period of 3.4 years. In addition, approximately \$1,100 in maintenance savings would be realized. A summary of the recommended ECOs is shown in Table 1.0.1. The recommended ECOs are prioritized by SIR. Table 1.0.2 lists non-recommended ECOs.

ECIP Projects: To qualify for an ECIP project, an ECO or group of ECOs must have a construction cost greater than \$300,000. In addition, a simple payback period of less than 10 years and an SIR greater than 1.0 must be achieved. Presently there is no single recommended ECO or groups of recommended ECOs which would qualify for ECIP funding. This finding was determined during the Pre-Final meeting on July 26, 1995. It should also be noted that ECO #9 is currently in the ECIP program.

Non-ECIP Projects: These are ECOs which do not meet the construction cost and payback period criteria, but have an SIR greater than one (1.0). All ECOs recommended ECOs into this category. In addition, there are some non-recommended which had SIRs greater than 1.0. Non-ECIP Projects are listed in Table 1.0.4.

**Table 1.0.1, Recommended ECOs, Prioritized by SIR**

<i>ECO #</i>	<i>ECO Description</i>	<i>Construction Cost</i>	<i>Energy &amp; Maint. Savings</i>	<i>Payback Period (yrs)</i>	<i>SIR</i>
1	Reduce Boiler Cycling	\$9,000	\$13,300	0.7	38.1
2	Expand Energy Monitoring and Control System	\$50,000	\$58,000	0.9	24.9
3	Shut off Boiler in Summer	\$14,000	\$11,400	1.2	20.1
4	Security Room AC Renovations	\$7,000	\$2,600	2.7	6.8
6	Reduce Building HVAC Outdoor Air Requirements	\$16,000	\$4,400	3.6	5.1
4A	Shutdown Chiller During Winter and Summer Unoccupied Periods	\$77,000	\$19,800	3.9	4.7
11	3' HPS Bollards	\$800	\$200	4.0	4.6
7	Replace Electric Dishwasher Booster Heater	\$20,000	\$5,000	4.0	4.0
8	100 Watt HPS Loading Dock Luminaires	\$6,500	\$1,200	5.4	3.4
5	Electric Cooking Equipment to Natural Gas	\$25,000	\$6,400	3.9	3.2
9	4' T-8 Lamp Retrofit	\$210,000	\$34,700	6.1	3.0
13	Motion Sensors	\$15,000	\$2,400	6.3	2.9
10	Reflectors	\$137,900	\$19,600	7.0	2.6
14	Exit Signs to LED	\$13,000	\$1,800	7.2	2.5
12	Replace 75 Watt Mercury Vapor Wall Washers	\$6,500	\$700	9.3	1.9
	Totals	\$607,700	\$181,500	3.3	

**Table 1.0.2, Non-Recommended ECOs, Prioritized by SIR**

<i>ECO #</i>	<i>ECO Description</i>	<i>Construction Cost</i>	<i>Energy &amp; Maint. Savings</i>	<i>Payback Period (yrs)</i>	<i>SIR</i>
E	Shutdown Chiller During Winter and Summer Unoccupied Periods	\$90,000	\$23,500	3.8	4.8
C	3' MH Bollards	\$800	\$190	4.2	4.1
F	Security Room	\$12,000	\$1,400	8.6	2.2
L	Electric Rate "GT-3B"	\$500,000	\$55,400	9.0	1.9
H	Peak Shaving with Diesel Generators	\$145,000	\$11,700	12.4	1.5
J	Oxygen Trim Controls on Boilers	\$22,000	\$1,100	20.0	1.3
G	Variable Frequency Drive Controllers	\$110,000	\$8,900	12.4	1.3
A	150 HPS Loading Dock Luminaires	\$6,500	\$400	16.3	1.1
B	2' and 3' T-8 Lamp Retrofit	\$19,000	\$1,100	17.3	1.1
K	PEPCO's Curtailment Program	\$145,000	\$8,400	17.3	1.0
I	Chilled Water Storage	\$290,000	\$10,300	28.2	0.6
D	Exterior Lighting	\$16,000	\$400	40.0	0.5

**Table 1.0.3, Recommended ECIP Projects, Prioritized by SIR**

<i>ECO #</i>	<i>ECO Description</i>	<i>Construction Cost</i>	<i>Energy &amp; Maint. Savings</i>	<i>Payback Period (yrs)</i>	<i>SIR</i>
1	No ECOs Qualify as ECIP Projects				
	Totals				

**Table 1.0.4, Non-ECIP Projects, Prioritized by SIR**

<i>ECO #</i>	<i>ECO Description</i>	<i>Construction Cost</i>	<i>Energy &amp; Maint. Savings</i>	<i>Payback Period (yrs)</i>	<i>SIR</i>
1	Reduce Boiler Cycling	\$9,000	\$13,300	0.7	38.1
2	Expand Energy Monitoring and Control System	\$50,000	\$58,000	0.9	24.9
3	Shut off Boiler in Summer	\$14,000	\$11,400	1.2	20.1
4	Security Room AC Renovations	\$7,000	\$2,600	2.7	6.8
6	Reduce Building HVAC Outdoor Air Requirements	\$16,000	\$4,400	3.6	5.1
7	Shutdown Chiller During Winter and Summer Unoccupied Periods	\$77,000	\$19,800	3.9	4.7
12	3' HPS Bollards	\$800	\$200	4.0	4.6
8	Replace Electric Dishwasher Booster Heater	\$20,000	\$5,000	4.0	4.0
9	100 Watt HPS Loading Dock Luminaires	\$6,500	\$1,200	5.4	3.4
5	Electric Cooking Equipment to Natural Gas	\$25,000	\$6,400	3.9	3.2
10	4' T-8 Retrofit	\$210,000	\$34,700	6.1	3.0
14	Motion Sensors	\$15,000	\$2,400	6.3	2.9
11	Reflectors	\$137,900	\$19,600	7.0	2.6
14	Exit Signs to LED	\$13,000	\$1,800	7.2	2.5
13	Replace 75 Watt Mercury Vapor Wall Washers	\$6,500	\$700	9.3	1.9
Totals		\$607,700	\$181,500	3.3	

Table 1.0.5 on the following page shows the comparison of existing energy use, and energy use after all recommended ECOs are implemented.

The following sections of this report describe in detail the findings as outlined above and contain the necessary cost estimate and calculation backup data as required. The reader is encouraged to carefully review each of the following report sections to understand the assumptions, methodology, and discussions involved.

**Table 1.0.5, Energy Use Before and After ECOs**

<i>Description</i>	<i>Existing</i>	<i>Proposed</i>	<i>Savings</i>	<i>Percent</i>
Total Energy Cost	\$444,600	\$264,210	\$180,390	40.6%
Total \$ per sf	\$1.83	\$1.08	\$0.75	41.1%
Total Energy (mmBtu)	30,399	17,000	13,399	44.1%
Total Energy (Btu/sf)	124,867	69,828	55,038	44.1%
Electric Usage (kWh)	5,080,693	2,696,959	2,383,734	46.9%
Electric Demand (kW)	12,388	9,041	3,347	27.0%
Electric Cost \$	\$345,300	\$205,010	\$140,290	40.6%
Electric Energy (mmBtu)	17,340	9,205	8,136	46.9%
Electric Energy (Btu/sf)	71,228	37,809	33,419	46.9%
Natural Gas Usage (mcf)	12,678	7,568	5,110	40.3%
Natural Gas Cost \$	\$99,300	\$59,200	\$40,100	40.4%
Natural Gas Energy (mmBtu)	13,058	7,795	5,263	40.3%
Natural Gas Energy (Btu/sf)	53,639	32,019	21,620	40.3%
Fuel Oil (gal)	0	0	0	0.0%
Fuel Oil Cost \$	0	\$0	\$0	0.0%
Fuel Oil Energy (mmBtu)	0	0	0	0.0%
Fuel Oil Energy (Btu/sf)	0	0	0	0.0%
Building Area	243,450	243,450	243,450	

# Marshall Hall, Energy Cost

Before and After ECOs

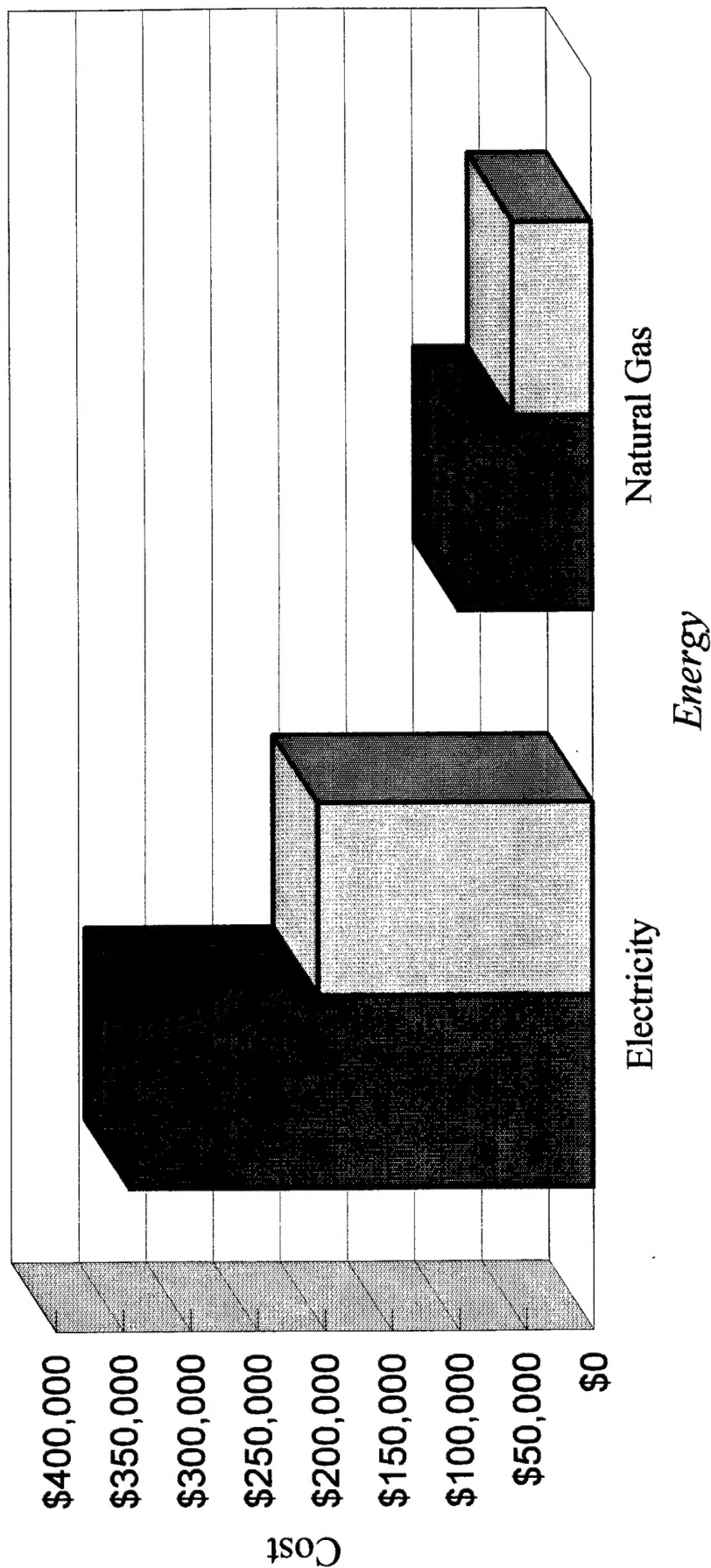
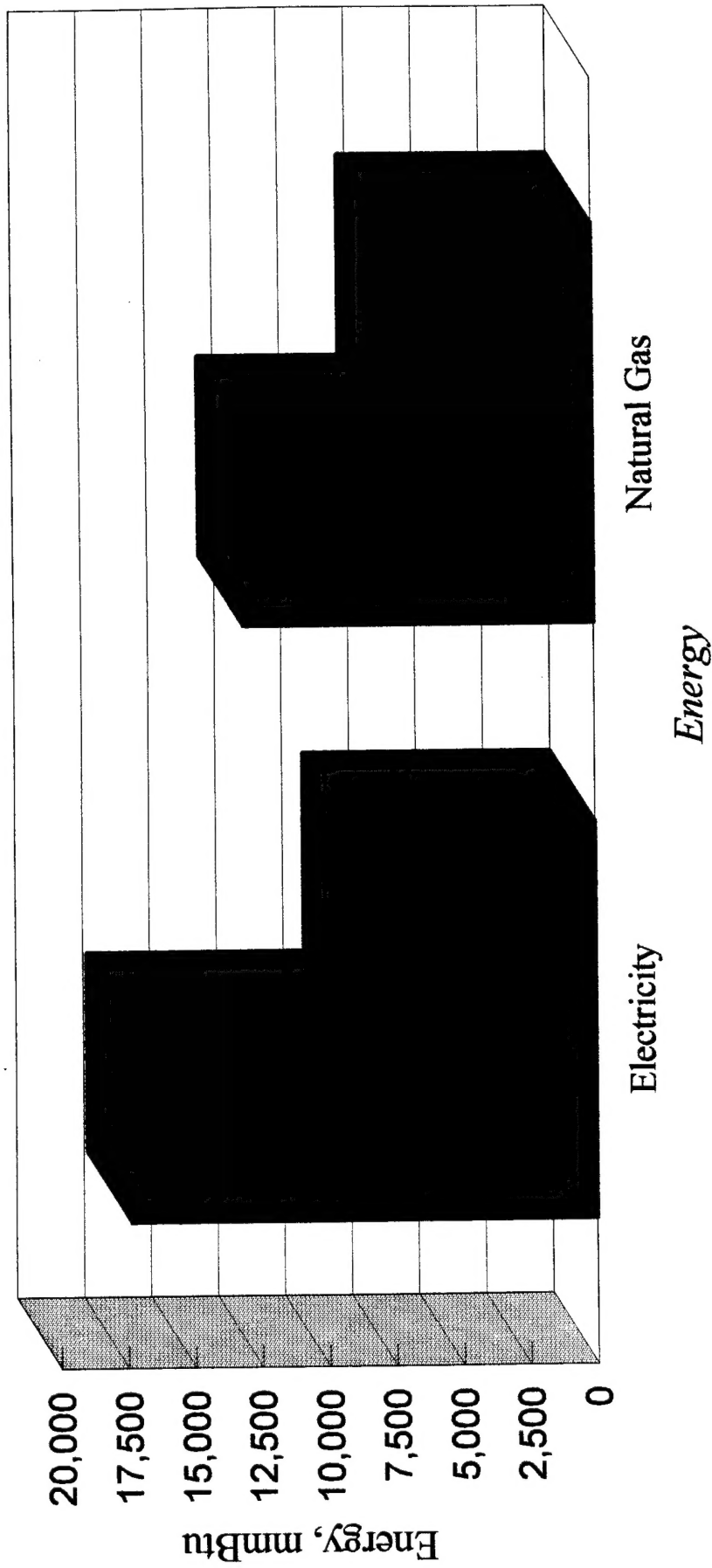


Figure 1.0.6

# Marshall Hall, mmBtu

Before and After ECOs



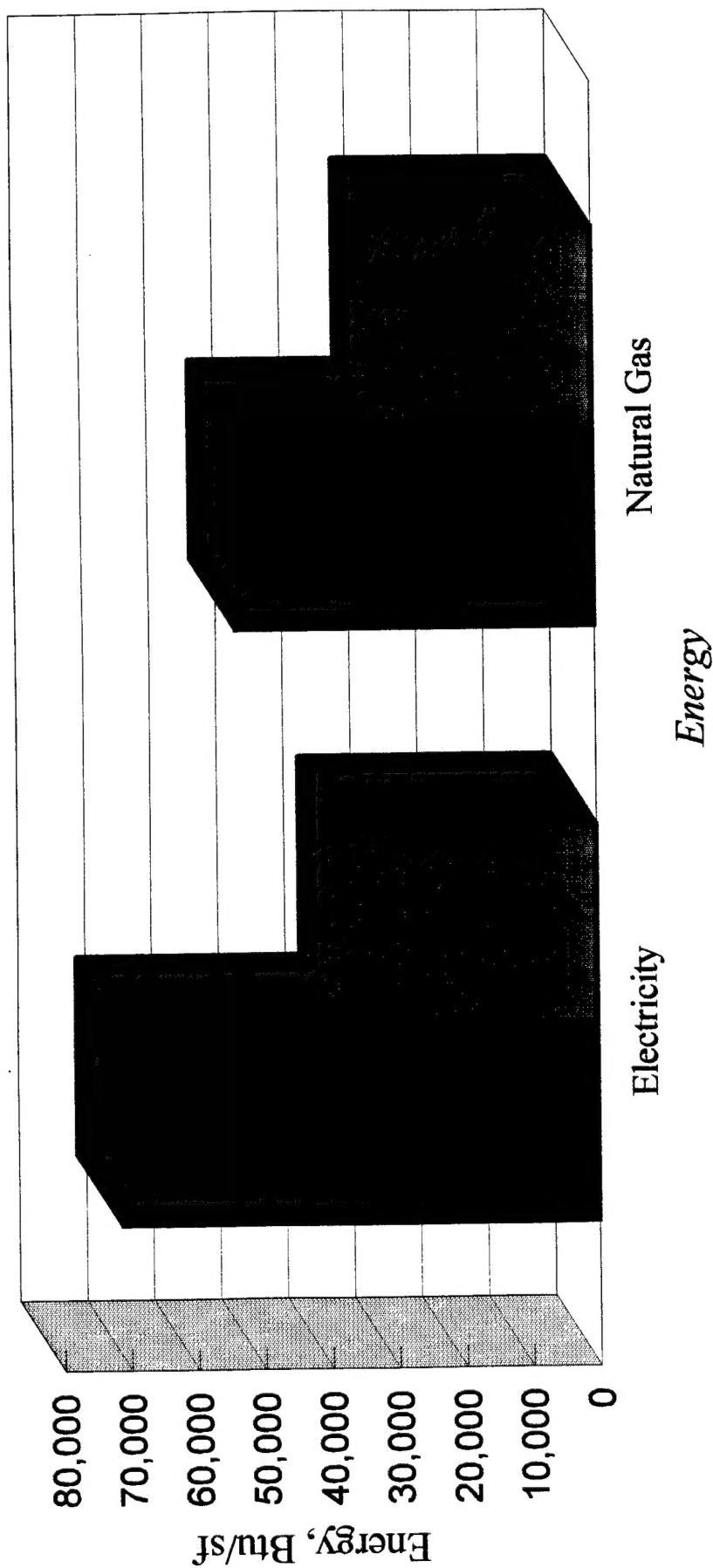
■ Before ECOs ■ After ECOs

Figure 1.0.7



# Marshall Hall, Btu/sf

Before and After ECOs



■ Before ECOs ■ After ECOs

Figure 1.0.8